

What's on the Horizon?

Issues for All of Us

NCTM Regional Conference & Exposition
Richmond, VA
October 10-12, 2007

Francis (Skip) Fennell, President
National Council of Teachers of Mathematics
&
Professor of Education
McDaniel College
Westminster, MD



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Exploring Mathematical Horizons

The theme for this conference!



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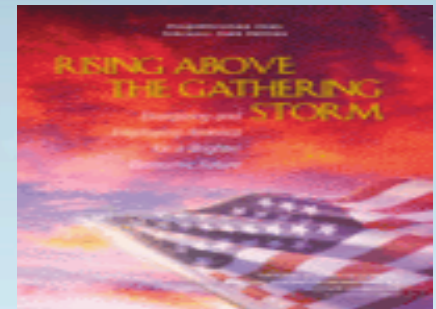
Coherence



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- 86% of U.S. voters believe that the U.S. must increase the number of workers with a background in science and mathematics or America's ability to compete in the global economy will be diminished.

- The Tom Friedman – effect!
- Competitiveness – an advantage for new ideas



From the Secretary...

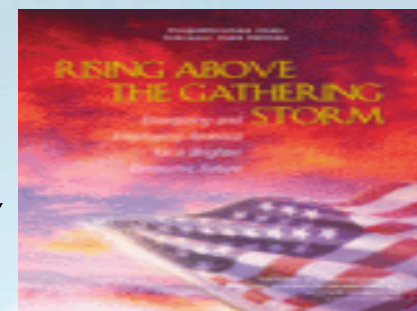
- “We must encourage students to take more advanced math and science classes. Employers today need workers with ‘*pocket protector*’ skills – creative problem solvers with strong math and science backgrounds.”

Margaret Spellings, June 21, 2007



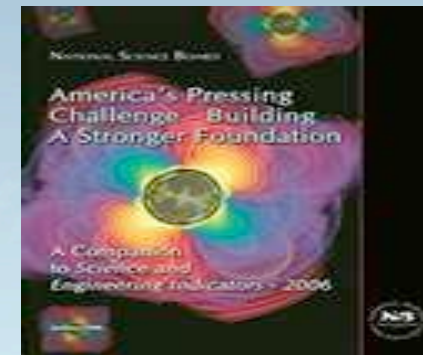
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RAGS Effect II



America's Pressing Challenge: Building A Stronger Foundation

- Our nation must devote the necessary resources now to revitalize our precollege STEM education system. We cannot wait for a new ***Sputnik*** episode to energize our population to rise to this challenge – we must recognize the existing crisis and take the necessary actions.



NSF, 2006



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Recent Good news...



- Highest scores ever – grade 4 mathematics
- Highest scores ever – grade 8 mathematics
- Increasingly diverse student population
- NMP and NAEP

No Child Left Behind Challenges

- Meeting AYP
- Highly Qualified Teachers
- Math for All
 - special education challenges
 - the continuing use of the word “subgroups”
- Overemphasis on high stakes assessments.
 - Life does not come at you in multiple choice moments



These challenges are diverting teachers from teaching, and driving them from the profession!



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And, from my sister...*

Madaline Fennell, the Nebraska teacher of the year: Teachers are asking for,

- fully funding education and assessment programs that are federally mandated;
- language that addresses the special needs of students with disabilities, such as implementing state assessment systems that track the academic growth of individual students;
- replacing penalties against failing schools with methods to enhance achievement;
- multiple methods of assessment that evaluate a student's progress over the entire year, instead of just through standardized tests.

Ms. Fennell said that while there are positive aspects to the law, it is also "fraught with numerous deficiencies." The expertise of teachers who have been chosen as the best of the best in their states, she said, can help lawmakers craft a better version of the No Child Left Behind Act. "Teachers need to be included in this reauthorization," she said. "Please, leave no teacher behind."

Challenges and Opportunities

- The Immediate Horizon
 - National Mathematics Panel
 - Math Now
 - NSB Initiative



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Why Identify Focal Points?

- Address long lists of state learning expectations
- Address “mile wide, inch deep” math curriculum
- Identify the mathematics that should be the focus of instruction and student learning, preK-8
- Begin the discussion of appropriate curricular expectations
- Identify key mathematical ideas all others build on



Number of 4th-Grade Learning Expectations per State by Content Strand

	Number & Operation	Geometry	Measurement	Algebra	Data Analysis, Probability & Statistics	Total Number of Learning Expectations
California	16	11	4	7	5	43
Texas	15	7	3	4	3	32
New York	27	8	10	5	6	56
Florida	31	11	17	10	20	89
Ohio	15	8	6	6	13	48
Michigan	37	5	11	0	3	56
New Jersey	21	10	8	6	11	56
North Carolina	14	3	2	3	4	26
Georgia	23	10	5	3	4	45
Virginia	17	8	11	2	3	41

Reys, et al., 2006

Principles

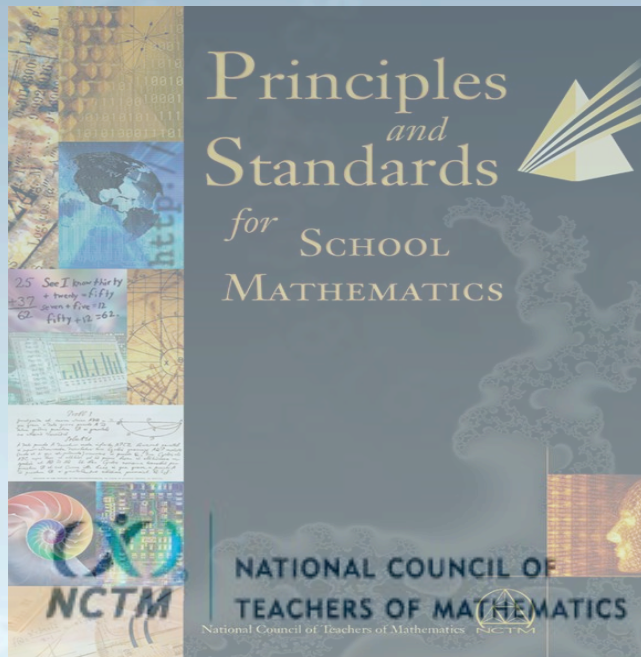
- Equity
- ***Curriculum***
- Teaching
- Learning
- Assessment
- Technology

Content Standards

- Number/Operations
- Algebra
- Geometry
- Measurement
- Data/Probability

Process Standards

- Problem Solving
- Reasoning
- Communication
- Connections
- Representation



This is NOT the next set of Standards!!!!

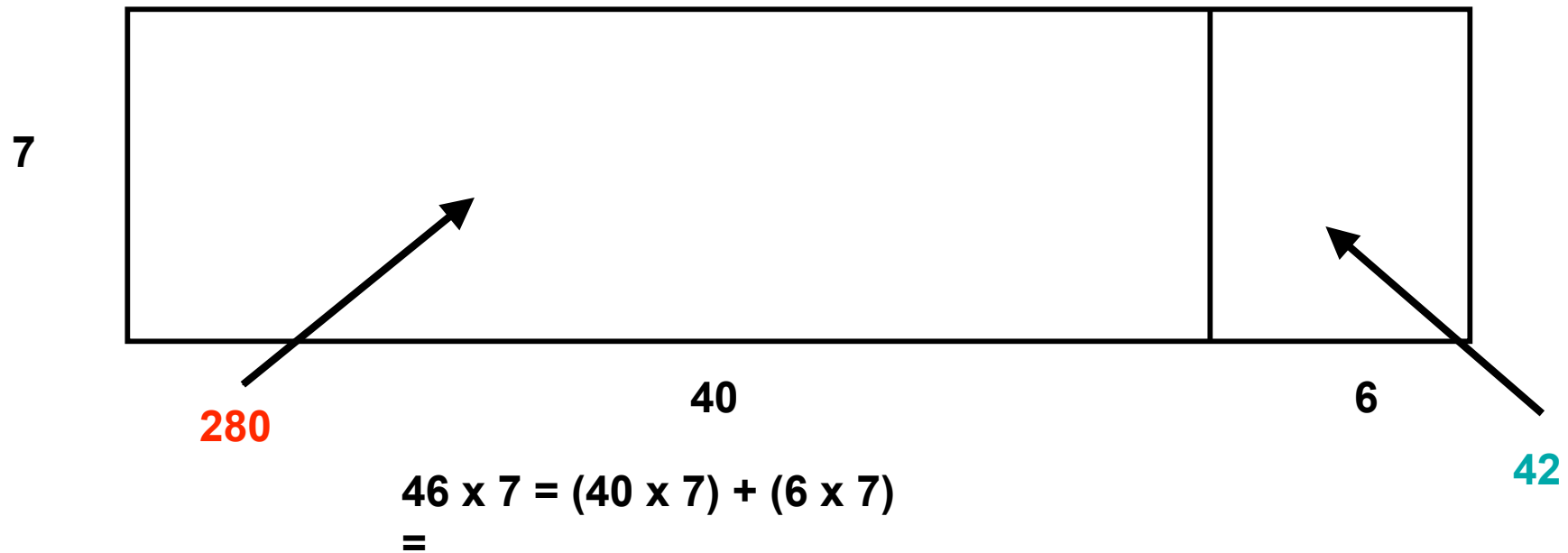
Curriculum Focal Points and Connections for Grade 4

The set of three curriculum focal points and related connections for mathematics in grade 4 follow. These topics are the recommended content emphases for this grade level. It is essential that these focal points be addressed in contexts that promote problem solving, reasoning, communication, making connections, and designing and analyzing representations.

Grade 4 Curriculum Focal Points	Connections to the Focal Points
<p>Number and Operations and Algebra: Developing quick recall of multiplication facts and related division facts and fluency with whole number multiplication</p> <p>Students use understandings of multiplication to develop quick recall of the basic multiplication facts and related division facts. They apply their understanding of models for multiplication (i.e., equal-sized groups, arrays, area models, equal intervals on the number line), place value, and properties of operations (in particular, the distributive property) as they develop, discuss, and use efficient, accurate, and generalizable methods to multiply multidigit whole numbers. They select appropriate methods and apply them accurately to estimate products or calculate them mentally, depending on the context and numbers involved. They develop fluency with efficient procedures, including the standard algorithm, for multiplying whole numbers, understand why the procedures work (on the basis of place value and properties of operations), and use them to solve problems.</p>	<p>Algebra: Students continue identifying, describing, and extending numeric patterns involving all operations and nonnumeric growing or repeating patterns. Through these experiences, they develop an understanding of the use of a rule to describe a sequence of numbers or objects.</p> <p>Geometry: Students extend their understanding of properties of two-dimensional shapes as they find the areas of polygons. They build on their earlier work with symmetry and congruence in grade 3 to encompass transformations, including those that produce line and rotational symmetry. By using transformations to design and analyze simple tilings and tessellations, students deepen their understanding of two-dimensional space.</p>
<p>Number and Operations: Developing an understanding of decimals, including the connections between fractions and decimals</p> <p>Students understand decimal notation as an extension of the base-ten system of writing whole numbers that is useful for representing more numbers, including numbers between 0 and 1, between 1 and 2, and so on. Students relate their understanding of fractions to reading and writing decimals that are greater than or less than 1, identifying equivalent decimals, comparing and ordering decimals, and estimating decimal or fractional amounts in problem solving. They connect equivalent fractions and decimals by comparing models to symbols and locating equivalent symbols on the number line.</p>	<p>Measurement: As part of understanding two-dimensional shapes, students measure and classify angles.</p> <p>Data Analysis: Students continue to use tools from grade 3, solving problems by making frequency tables, bar graphs, picture graphs, and line plots. They apply their understanding of place value to develop and use stem-and-leaf plots.</p>
<p>Measurement: Developing an understanding of area and determining the areas of two-dimensional shapes</p> <p>Students recognize area as an attribute of two-dimensional regions. They learn that they can quantify area by finding the total number of same-sized units of area that cover the shape without gaps or overlaps. They understand that a square that is 1 unit on a side is the standard unit for measuring area. They select appropriate units, strategies (e.g., decomposing shapes), and tools for solving problems that involve estimating or measuring area. Students connect area measure to the area model that they have used to represent multiplication, and they use this connection to justify the formula for the area of a rectangle.</p>	<p>Number and Operations: Building on their work in grade 3, students extend their understanding of place value and ways of representing numbers to 100,000 in various contexts. They use estimation in determining the relative sizes of amounts or distances. Students develop understandings of strategies for multidigit division by using models that represent division as the inverse of multiplication, as partitioning, or as successive subtraction. By working with decimals, students extend their ability to recognize equivalent fractions. Students' earlier work in grade 3 with models of fractions and multiplication and division facts supports their understanding of techniques for generating equivalent fractions and simplifying fractions.</p>

Boxes to multiply...

- Draw a rectangle to show $46 \times 7 = 322$



$$280 + 42 = 322$$

Connections – Division & Mental Math

- 275 divided by 5
- Starter problem $250 \div 5$
- Quinn found 77 beads in a drawer. He was using them to make bookmarks. If he used 5 beads for each bookmark. How many bookmarks could he make?
- Starter problem $50 \div 5$

Navigations 3-5, Number and Operations, 2007

Curriculum Focal Points: What's New

- Priorities - focus
- Grade-by-grade descriptions
- Descriptive clusters of content
- More clarification
- Connections



National Science Board Report

...the U.S. should “define the essential knowledge and skills needed at each grade level” ...and the curriculum focal points provide a “model for the development” of content guidelines for mathematics instruction.



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Coherence - Who cares?

- Congress
- Publishers
- United States Department of Education
- NSB
- NSF
- Parents
- 37 of 42 state coordinators of mathematics...
- Others...

- And most importantly, YOU care!



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September 12, 2006

Arithmetic Problem

New Report Urges Return to Basics in Teaching Math

By JOHN HECHINGER

Critics of 'Fuzzy' Methods Cheer Educators' Findings; Drills Without Calculators

The nation's math teachers, on the front lines of a 17-year Curriculum war, are getting some new marching orders: Make sure students learn the basics.

April 13, 2000

Math Teachers Back Return Of Education in Basic Skills

By ANEMONA HARTOCOLLIS

In an important about-face, the nation's most influential group of mathematics teachers announced yesterday that it was recommending, in essence, that the arithmetic be put back into mathematics, urging teachers to emphasize the fundamentals of computation rather than focus on concepts and reasoning.

It's not about basics

What are the critical foundations ALL students need?

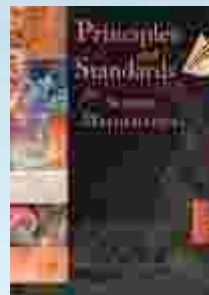


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- Children should master the basic facts of arithmetic that are essential components of fluency with paper-pencil and mental computation and with estimation.
- It is important for children to learn the sequence of steps – and the reason for them – in the paper-and-pencil algorithms used widely in our culture.



PreK-4 – Curriculum and Evaluation Standards, NCTM, 1989, p.47



Importance of Computational Fluency, NCTM, 2000, 32



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Mathematics is the gateway to good jobs!



But it's not just
Algebra II



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Algebra Issues

- What is algebra?
 - When?
 - Who's the teacher?
-
- And, then what?
 - Stay tuned for the NMP Report

Parents and Others...



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More and better mathematics for all students

This is an imperative for America's
competitiveness.



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Do the kids care that Singapore is #1?

And yet...

Ewing Marion
KAUFFMAN
Foundation

- ***Important, but NOT for me***
 - Parents are aware of the importance of math, but remain complacent
 - Students pay lip service to the importance of higher level math...



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- ...math and science are the keys to innovation and power in today's world, and American parents had better understand that the people who are eating their kids' lunch in math are not resting on their laurels.



Tom Friedman, 2005



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A math teacher's recurring nightmare

- “Ya, know, I was never good in math either.
- What you might like to say?
 - Can ya read the newspaper?
 - Do you think parents from Singapore say that?
 - Wouldn't you want something better for YOUR child?

Engaging/Involving Parents

- Parent Conferences – communication
- Before AND After School meetings
- Math Nights
- Math in the Mall
- Math Clubs and more
 - MATHCOUNTS
 - Math Kangaroo
 - Etc.

MATHCOUNTS®



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Trying to Avoid!

Parents with Pitchforks!



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“The Happiness Factor”

A good thing!



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My thinking...

- We want all students to be curious about the mathematics they are learning.
- We also want students to persevere.
- They should look for different ways to solve problems, find their own solutions, work to get the answer and also understand why things work.
- **If our students enjoy the subject and approach it with curiosity and confidence as well as the perseverance that embraces struggle within mathematics learning—what then? Well, just maybe our students will be more competitive and as they continue to mature value the importance of mathematics learning.**

An observation



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Teacher Background Issues



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If we don't step up to the challenge of finding and supporting the best teachers we'll undermine everything else we are trying to do to improve our schools.



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Louis Gerstner, former Chair, IBM

Why did you become a mathematics teacher?

- Love of the subject
- “I knew I could get a job”
- Change the world syndrome
- Parental influence – “we, in my family, are all teachers.”



Knowing the Mathematics for Teaching

- Knowing mathematics for teaching demands a kind of depth and detail that goes way beyond facility in carrying out the steps in an algorithm reliably.



Ball, Hill, Bass, 2005



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What do we know about teacher learning?

- More (mathematics) is not necessarily better.
- That's not to say more (mathematics) is a bad idea. Teachers need to know mathematics, but know it differently than mathematicians.

Mathematical Demands of Teaching

- Using materials
 - Textbooks
 - Supplementary publications
 - Technological tools, including websites...
- Present content – how?
- Answering student questions
- Assess student work – class responses, homework, assessments

All of the above require mathematical knowledge

Mathematical Demands of Teaching (more)

- Using and analyzing representations
- Defining terms and regularly attending to the language of mathematics
- Using and sometimes inventing notation
- Producing and analyzing explanations
- Generating simpler and more complex versions of problems
- Asking questions
 - Why does this work? Will this always work? Can you show me another way?
- Thinking of special cases that might **push** an idea further

Teaching Mathematics – An Unnatural Act?

- Listening and watching others work.
- Being in your professional role!
- Probing ideas
 - Can we think of this differently?
 - Can you show me another way?
 - What have we learned here?
- Provoking disequilibrium and error
- Seeking to learn others' experiences and perspectives.
- Seeing and accepting people, responses, etc.

Immersion Issues

- Mentors – why?
- Things nobody told me about:
 - The principal
 - The secretary
 - The custodian
- The faculty lounge
- AYP and NCLB and other accountability issues



But, what about...

- Supervision issues!
- Getting along with others
- Finding stuff – copy machine wars!
 - Locating a printer
 - Cartridges!
- Day-to-day victories and losses

SCHOOL CULTURE ISSUES



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Do you remember?

- When I got everything done, I just sat down in the middle of my room and cried.



- Why are you trying to teach us things we don't know...

Jim Rubillo



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“I didn’t call myself anything. I was more than a teacher. And less. In the high school classroom you are a drill sergeant, a rabbi, a shoulder to cry on, a disciplinarian, a singer, a scholar, a clerk, a referee, a clown, a counselor, a dress-code enforcer, a conductor, an apologist, a philosopher, a collaborator, a tap dancer, a politician, a therapist, a fool, a traffic cop, a priest, a mother-father-sister-brother-aunt-uncle, a bookkeeper, a critic, a psychologist, the last straw.”

“Teacher Man” Frank McCourt (p.19, 2005)

From a 2nd year teacher

- When I started teaching I was really glad I had the school district expectations/objectives, but now I realize that last year, I just kept teaching and teaching, never realizing they weren't getting any of it!

Why do they leave?

- Too little planning time,
- Too much paperwork
- Unreliable assistance
- **A general lack of support, including limited pay!**
- **We must sustain and support teachers!**
- And then: “There is a trust there (at my school). They look at me as a professional, and it really makes or breaks whether you stay.”



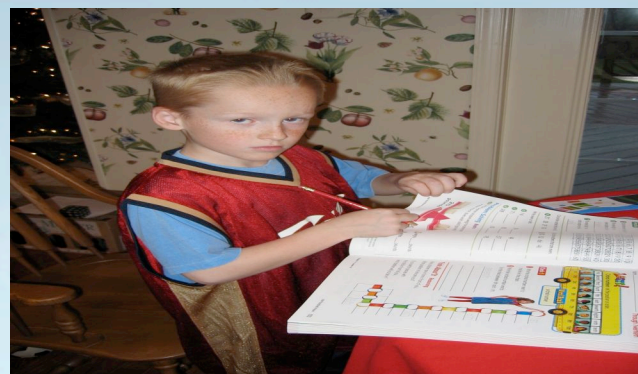
Validation



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We share a responsibility

This must be a concerted team effort, it's about every child every day.



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Horizons

- Curricular Coherence
- Parents, Families, Communities
- Teachers and Teacher Education

Be Ready!



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